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Performance Obstacles Associated with Train Drivers

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ABSTRACT

Train driving is among safety critical jobs which a few studies have investigated their working conditions. This study aimed to find and prioritize performance obstacles associated with Iranian train drivers from an ergonomic viewpoint. Based on the results of semi-structured interviews with 15 train drivers, a questionnaire was developed and after confirming its reliability and validity it was used for investigating performance obstacles among a sample of 100 train drivers. Performance obstacles were classified into five categories: environmental factors, task-related factors, social, individual, and organizational factors. It was found that the major problems of train drivers within these categories were collisions with people, excessive and irregular working hours, work schedule interference with personal lives, failure to meet train drivers job expectations and insufficient job benefits. In conclusion, implementation of intervention strategies based on the determined obstacles can improve train drivers working conditions and subsequently enhance the efficiency of railway system.

Keywords: Ergonomics, Railway Industry, Train Driver, Performance Obstacles

INTRODUCTION

Nowadays, railway plays a special role amongst various transport systems. Despite the high level of safety in rail system, rail accidents negatively impact the organization, victims, and surrounding communities and result in loss of lives and severe adverse economic effects (Chung et al., 2003; Chung et al., 2001; Hagströum, 1995; Malt et al., 1993). The costs of rail accidents are considerably high and identifying the underlying causes of these accidents will enhance the quality and efficiency of rail transport system.

Previous studies have identified human errors as the main contributing factor in occurrence of train accidents (Buck and Lamonde, 1993; Edkins and Pollock, 1997; Wilde and Stinson, 1983). Train driving is an important and safety critical job within railway system. Train driver has to deal with a high level of demands and responsibilities (Kecklund et al., 1999). It is a kind of job which requires many cognitive functions such as sustained attention (Chang and Ju, 2008; Edkins and Pollock, 1997; Wilde and Stinson, 1983), object detection and recognition,

memory, planning, decision-making, and workload management (Chang and Ju, 2008). Porter (1992) introduced the specific required skills of a train driver as: the ability to remember and recall information, the ability to think ahead and evaluating the influence of different factors that may affect train, fast reaction time, control skills, and the ability to keep vigilance and concentration (Whitlock et al., 2005). Train driving involves a great deal of monitoring work (Kecklund et al., 1999). In addition, earlier studies has shown a number of factors which train drivers exposed to, such as physical working conditions (vibration, cab climate, noise etc.), irregular working hours, sleepiness, fatigue, workload etc. The collection of aforementioned factors can have deteriorating effects on the train drivers in different aspects.

Based on the Balance Theory of Job Design, developed by Carayon and Smith (2000), a work system is made of five elements: task, organization, physical environment, technologies-tools, and individual which their interactions determine the total work system. The interactions of these five elements impose demands on the operator and when demands exceed the operator's capacity, it leads to stress and low performance (Carayon and Smith, 2000; Smith and Carayon, 2001; Smith and Sainfort, 1989). According to this theory, work system design characteristics impact train drivers' performance and also work-related quality of life, including job satisfaction, well-being, stress, absenteeism rate, turnover and so forth on (Gurses et al., 2009b; Sani and Dawal, 2010). Therefore, identifying those obstacles, which affect train drivers' performance, will help to improve their work settings and subsequently to enhance the whole system efficiency. In particular, identified obstacles can be applied when redesigning the work system in a micro level approach (micro ergonomics).

The concept of performance obstacle is similar to negative factors in Balance Theory (Carayon and Gurses, 2007). Inspiring by Peters and O'Connor (1988), we considered performance obstacles as the work system characteristic which train drivers perceive to negatively impact their performance.

Railway system in Iran has many problems, which affect train drivers' performance. It has been established since many decades ago, and the trains and railroad tracks are mainly old. Different models of train locomotive (such as General Motors, Siemens, General Electric, Alstom, Hitachi) are used in Iranian railway industry which in most cases they are not ergonomically well-designed. Despite the abovementioned problems in Iranian railway systems and its recent expansion, no previous researches have systemically identified contributing factors in the train drivers' work system in Iran. Therefore, the aim of the present study was to find performance obstacles associated with Iranian train drivers. The result of this study would be useful to prioritize intervention strategies in order to improve working conditions in Iranian railway system. The main framework of the present study was adopted by the previous research which was done by Gurses and Carayon (2009a). They analyzed performance obstacles of ICU nurses from the Balance Theory viewpoint.

METHODS AND MATERIALS

The present research was a descriptive and cross-sectional study which was conducted among 100 train drivers, who were all male. The study was carried out in four stages:

Stage I

In the first stage a literature review, based on the previous researches, was done in order to achieve a global image of performance obstacles associated with train driving. The published articles in the context of the subject were searched in scientific databases including PubMed, Google Scholar, and ScienceDirect. Titles and abstracts were searched on Jun 2012 using the combination of keywords "Train Driving", "Ergonomics", "Working Condition", "Work-Related Problems", and "Performance".

Stage II

In this stage, semi-structured interviews were done with 15 experienced train drivers. Sample size for interview was determined by collecting data until the researchers feel that new data no longer generate additional information around the research topic (Mack et al., 2005). The question was similar to what Gurses et al. (2009b) used to explore performance obstacles of ICU nurses. According to the keywords that train drivers used in their statements, 47

performance obstacles were identified and they were categorized into five groups: environmental factors (physical factors, design-related factors, working condition), task-related factors, social factors, individual factors, and organizational factors.

Stage III

In the third phase, a questionnaire including 47 questions (in five categories) was developed. The content validity of the questionnaire was determined by a panel of head drivers and experts (including six head drivers, three ergonomists and also one occupational health engineer). Moreover, the Cronbach's alpha was calculated in order to assess the internal consistency of the questionnaire items.

Stage IV

Finally, in the last stage 100 train drivers filled out the self administered questionnaire in the depot. Participants were asked to show the degree of their agreement with each item using 5-point rating scales where 0=strongly disagree, 1=disagree, 2=neither agree nor disagree, 3=agree, and 4=strongly agree.

Table 1: Result of interview with train drivers including their statements

Train drivers' statements	Working obstacles	Main categories
– Engines vibrations which transmitted to the cabin – Transmission of vibrations to the body through seat – Shakes and rattles of wheel-rail track rolling – Old engines and gears which produce high amount of vibration	Vibrations of cabin	Environmental factors (physical factors, design related factors, working condition)
– Sound due to the vibration – high level of noise due to old locomotives – Interference of noise to speech with assistant especially in tunnels	Extreme noise level	
– High level of noise while entering the tunnel which annoys ears and the need to use earplug in the tunnel	Ear discomfort due to entering into tunnels	
– Damage to face and hand skin due to direct sunlight – The lack of window sun block in the cabin and annoying sun glare – Sun light limits the ability to see signs	Sun glare while driving	
– The lack of proper heating system – The lack of proper insulation of door and windows – The seat is near the window and the cold air comes in. – Sometimes engine cooling water circuit is frozen due to the cold weather and it makes the cabin colder.	Extreme cold in cabin in winter	
– Being away from family – Being informed of the schedule 24 hours prior to the shift which sometimes disrupts family planning – Disruption of regularity in personal life	Work schedule interference with personal lives and leisure activities	
– Everywhere the tracks are near residntial area, accessibility to tracks is easier and the likelihood of collisions is more and drivers experience more stress in these places. – The brake has a slow reaction time and when driver sees an obstacle it takes at least 150 meters after braking to stop, which means the situation is out of driver control. – Feeling depressed after collisions – Stress of collision with track maintenance workers – There is no fence or separation grid around the rail tracks.	Collisions with people resulting in death or injury	
– There is no toilet in any of the train drivers' cabin. – Suffering from kidney problems	Unsatisfactory toilet facilities	
– When driver sees an obstacle it takes at least 150 meter after braking to stop which means the situation is out of driver control. – After collision with an animal, the driver can't stop and should continue the trip. This collision has negative effects on driving during the rest of the trip.	Collisions with animals	

– It is seen that people from other trains or children around the rail tracks throw objects toward cabin. – It is seen that people from other trains or children around the rail tracks throw objects toward cabin.	Sabotage: objects being thrown at the train	
– One of the train drivers lost about 30 percent of his vision due to an object that was thrown toward the cabin window. – One of the train drivers lost about 30 percent of his vision due to an object that was thrown toward the cabin window.		
– Some of the drivers manipulate the dead-man pedal in order to deactivate audible warning of this pedal.	The annoying sound of dead-man pedal	
– Discomfort and fatigue of foot due to the repetitive task of pressing dead-man pedal – The small size of the pedal which is not comfortable	Driver's fatigue due to using dead-man pedal	
– Sometimes in the middle of the tunnel a passenger press emergency bell which impose a high amount of stress to train driver. – Sometimes due to a sudden stop, passengers in the corridor fell down and hurt.	A sudden stop in response to an emergency bell	
– Seats cannot damp the vibrations effectively.	Uncomfortable and non-adjustable seat inside the cabin	
– The seat does not support head and neck. – The ability to revolve is the only feature of train drivers' seats ad there are no other adjustment.		
– There is not proper insulation for body of the cabin which causes heat absorption. – The lack of proper cooling system which sometimes during summer months, especially trips to the south of the country which the weather is hot, cause heatstroke.	Extreme heat in cabin in summer	
– Dazzling lights of some of the external signals – Poor light of some signals which train drivers miss it	Too bright or low light external signals on both sides of the track	
– Lack of ventilation system in the cabin – In some places there are small factories near to rail tracks and they use garbage as fuel which produces toxic and dangerous fumes and train drivers have to use mask. – Since the surface of the cabin is always greasy the cleaners clean it by gasoline and therefore there is always a disgusting smell in the cabin.	Gas and dust fumes in cabin	
– The locomotives are not made in Iran and the sizes are not appropriate especially for seat. – The seat and control panel is not appropriate for train drivers with high percentile of anthropometric dimensions	Mismatch between the sizes of seat and control panel and drivers anthropometric dimensions	
– Poor visibility on the sides of the train especially in the areas with curvature/tunnels – In one type of the locomotives, the seat and control panel are located obliquely and the forward visibility is poor	Difficult visibility in the forward/reverse direction from driver cabin	
– Poor lighting – Lighting level cannot be adjusted – Inappropriate location of the lighting sources	Inadequate lighting in cabin during night	
– The cabin light is located far from the console. – Console stand is vertical and there is no apace for train driver to get his knee under console. – The heater is located exactly on the back of the train driver seat.	Inappropriate arrangement of equipment and tools within cabin (the cabin lights, heater, . . .)	
– Improper accessibility to the handles on the control panel due to the vertical position of the control panel	Improper controls equipment layout (handles, gears, . . .) on the control panel	
– Tachometer sometimes does not show the correct speed. – Failure of indicators and signs due to being old	Difficulty in using signs and indicators (pressure gage, warning lights, . . .)	
– High concentration in order to monitor track, train, and signals – The importance of keeping concentration over long duration of shifts and during unusual time including early morning and night	Requiring high level of concentration	**Task related factors**
– Fast Decision making and reaction – Being responsible both for passengers and train	High responsibility	

– React quickly and calmly to unexpected events and emergency situations		
– Low control over the program – Everything is predetermined.	Time pressure due to tight timetable	
– Driving in an specific route for a long time – Driving in the routes with low environmental stimulus	Driving during monotonous routes	
– Variation in the design features and function of different types of locomotives – As every locomotive is different, train drivers sometimes overloaded because in addition to knowing how the locomotive works, they should also know all technical issues related to the engine and other parts of the locomotive	Different locomotives and necessity to learn too much information	
– Lack of opportunity to communicate with other colleagues – Working alone in a limited space – No facilities provided for travelling between home and work – Travelling between work and home, regarding the inappropriate location of the depot, takes train drivers' time and energy	Social isolation on the job Time consuming travelling between home and work	**Social factors**
– Low salary – High work demand in comparison to what train drivers thought before employment – Lack of incentive systems – Lack of recognition	Failure to meet train driver's job expectations	**Individual factors**
– Collisions with peoples which result in depression – The high level of stress	Lack of emotional fitness	
– Problems of being a morning/evening person in night/early morning shifts – Sitting position for a long duration which cause back pain	lack of physical fitness	
– Salaries are low. – Low level of amenities both in cabin and resting place	Insufficient job benefits	**Organizational factors**
– Meals are distributed at irregular time and the quality is low.	Unsatisfactory meal facilities	
– Discrimination in annual evaluations – Lack of proper reward and punishment system	Inappropriate job promotion process	
– It is observed that some drivers exceed the speed limit and no action is taken against them. – Reduction in human resources and using retired train drivers by the organization	Inconsistency between constitution, discipline, rules and the administrative actions	
– Stops due to accidents, damages to wagons, damages to the tracks, natural factors such as rainfall and storm – lack of coordination between controller, train driver, and shunter	Unscheduled train stops	
– Discontinuity of courses after employment – New technologies related to their job are not introduced to them on time	Insufficient training and refresher courses	
– Some of the courses remain incomplete. – The content of the training courses are not fresh and up-to-date. – Old teaching methods are used in courses and any discussion or other collaborations are not involved in these courses.	Low quality training courses	
– The work schedule is determined on time. – Irregularity in shifts and lack of a fixed structure for shifts schedule	irregular work schedule provided by the relevant department	
– Train drivers believe that training courses do not add any more information to them and these courses are repeated without any differences in their content	Unnecessary of training courses	

RESULTS

Literature Review

According to result of the literature review, five studies were directly related to the topic of the present research (Austin and Drummond, 1986; Baysari et al., 2008; Grabarek, 2002; Koohi, 2009; Žnidarič et al., 2011). A brief

description of these researches is presented in Table 1. Additionally, Stevenson et al identified and assessed ergonomics problems in the train cab covering different points related to cab arrangements before and after of redesigning. Other efforts related to cab design was done by Mack et al. (2004) and Steinicke and Meissner (2003). In addition to the mentioned studies, a number of researches emphasized on the effects of train drivers' performance on the work outputs and they modeled train drivers' performance. McLeod et al., 2005 model train drivers' performance with the Automatic Warning System (AWS) using contextual and situational factors based on cognitive approach. Hamilton and Clarke (2005) modeled train drivers' performance which the results could be applied in the design process. In fact the main focus of this study was to find a basis for location of both in-cab and outside cab information. Sani and Dawal (2010) proposed a performance model for Malaysian train drivers, based on Baines et al human performance modeling, in which, individual factors (internal group), physical and organizational environment (external group) are the basic affecting factors of train drivers. The result of the literature review also indicated a number of researches which were specifically related to topics such as working hours, fatigue, workload, stress etc. among train drivers.

Table 2: The result of literature review

No	Author/Year	The main aim	Understudy factors	The most important issues
1.	Austin, A., Drummond, P.D., 1986	Investigating work problems associated with suburban train driving in Australia	-Safety -Work hours -Physical working environment -Driving task -Working conditions	-Safety issues (fatal train accidents, persons on the track, vandalism, sudden signal changes, no emergency communication system in the driver's cabin) - High demand for mental concentration -Irregular working hours -Ear discomfort on entering tunnels
2.	Koohi, I., 2009	Investigating factors that influence train drivers performance in Iran	-Physical conditions of work place -Driving space -Tools and equipments -Skeleton and muscular complains -Administration	Cabin temperature/effect of cold weather/night view/air conditioning within the cabin/gas fumes/uncomfortable train rider seat/guidance panel/control equipments/indicators,/vision problems/hearing problems/professionalism/ breakdown of wireless systems/extreme exhaustion of train driver/breakdown of tools/hard working conditions/back exhaustion/back pain/general pressure
3.	Žnidarič, M., et al. 2011	An ergonomics survey of train drivers' work and workplace in India	-Controls layout on the control panel -Comfort and adjustability of the driver's seat -In-cab climate -Visibility from the driver's cab -Noise and its effect on driver performance -Impact of surroundings on driver work -Physiological disorders during the work-time -Performing physical exercise during the work-rest	-Comfort and adjustability of drivers' seat, -Dazzling headlights of the road vehicles travelling along the railway line -In-cab climate -Visibility in the reverse direction.
4.	Grabarek	Ergonomic analysis of the train driver's workplace in an electric locomotive	-Human factor: psychophysical condition, adaptation to work, mental effort, job experience, physical effort -Construction-technological factor: track visibility, seat design, visibility of steering and signaling equipment, workplace spatial structure, distribution of other equipment -Material environment factor: noise, vibration, microclimate, lighting, dust pollution	-Adaptation to work -Track visibility -Noise

5.	Baysari, M.T., et al. 2008	Identifying underlying contributing factors in rail accidents/incidents	- Unsafe acts - Preconditions for unsafe acts - Unsafe supervision - Organizational influences	-Equipment failure (inadequate maintenance or monitoring programs -Slips of attention (i.e. skilled-based errors) -Decreased alertness, physical fatigue, inadequate equipment design (e.g. driver safety systems), - Organizational influences (including: resource management, organizational climate, and organizational processes)

Interviews

The average age of interviewees was 48.4 years. Brief comments of the interviewees are presented in Table 2. For the items: fear of falling asleep during driving, becoming very drowsy while driving, consecutive night and early morning shifts, excessive and irregular working hours, and inadequate lighting in cabin during day, train drivers only had mentioned them as problems without any more statements.

Self-Administered Questionnaire

Regarding the content validity, 100 percent of head drivers evaluated the relevance and comprehensiveness of the questions as very relevant and comprehensive. For the clarity, four out of six head drivers believed that the questions are clear and the other two head drivers believed them to be clear but need minor changes. For instance, they believed that some examples of indicators, and equipment and tools should be added in the questionnaire. Spearman correlation demonstrated good test-retest reliability for the performance obstacle questionnaire (Correlation Coefficient 0.897). Furthermore, the administered questionnaire was shown to have a high internal consistency (Cronbach's alpha 0.93). Participants were, on average, aged 37.29±8.78 years with average work experience of 14.1±9.07. Moreover, participants aged 31-40 reported to have the highest relative frequency (52.5).

The mean score of each item was used to find problems priorities. The results are presented in Table 3. Data are given as mean (SD) values derived from 5-point rating scales. The last column of the table shows percentage of train drivers who selected 3 or 4 in the scale for each item of the questionnaire. We considered an obstacle as very important, if the percentage of participants who had selected 3 or 4 (in rating scale) for that obstacle was more than 75 percent.

Table 3: Mean score and % of drivers selecting 3 or 4 for each item

	Questionnaire items	Mean (SD)	% of drivers selecting 3 or 4
	Environmental factors (physical factors, design related factors, working condition)		
1	Collisions with people resulting in death or injury have negative impacts on me.	3.94(0.35)	99
2	Toilet facilities are unsatisfactory.	3.83(0.57)	94.9
3	Collisions with animals have negative impacts on me.	3.82(0.48)	98
4	Sabotage (objects being thrown at the train) makes problems for me.	3.77(0.51)	98
5	Exposure to vibrations of cabin annoys me.	3.37(1.10)	88.9
6	Extreme noise level in cabin is annoying.	3.36(1.19)	86.6
7	Entering into tunnels makes ear discomfort for me.	3.30(1.17)	81.8
8	The sound of dead-man pedal is annoying.	3.20(1.14)	83.8
9.	Using dead-man pedal is tiring.	3.18(1.17)	81.8
10.	Sun glare while driving interferes in my task.	3.17(1.29)	83.8
11.	A sudden stop in response to an emergency bell makes problems for me.	3.07(0.97)	80.8
12.	Seat inside the cabin is uncomfortable and non-adjustable.	3.02(1.50)	75.8
13.	Extreme heat in the cabin during summer is annoying.	2.97(1.60)	74.5
14.	There are too bright or low light external signals on sides of the tracks which make some problems for me.	2.94(1.27)	77.8
15.	Extreme cold in the cabin during winter is annoying.	2.93(1.58)	76.8
16.	There is gas and dust fumes in cabin which is annoying.	2.89(1.48)	75.8

17.	There is a mismatch between the sizes of seat and control panel and my body dimensions.	2.37(1.51)	60.2
18.	The cab does not allow good visibility in the forward/reverse direction.	2.11(1.44)	47.5
19.	Lighting in cabin during night is inadequate.	2.08(1.48)	48
20.	Arrangement of equipment and tools within cabin (the cabin lights, heater . . .) is inappropriate.	1.79(1.38)	33.3
21.	Controls equipment layout (handles, gears . . .) on the control panel is inappropriate.	1.52(1.21)	25.3
22.	I have difficulty in using signs and indicators (pressure gage, warning lights . . .).	1.29(1.13)	18.2
23.	Lighting in cabin during day is inadequate.	1.21(1.43)	20.2
	Task related factors		
24.	Excessive and irregular working hours negatively impact my performance.	3.65(0.93)	92.9
25.	My job requires high level of concentration.	3.64(0.88)	92
26.	High responsibility in my job makes me stressful.	3.52(0.86)	92.9
27.	My job involves consecutive night and early morning shifts which is annoying.	3.36(0.95)	88
28.	I have fear of falling asleep during driving.	3.25(1.13)	82
29.	I become very drowsy while driving.	3.23(1.20)	78.8
30.	Time pressure due to tight timetable annoys me.	3.12(1.10)	77.3
31.	My job involves driving in monotonous routes which is annoying.	2.51(1.29)	59.2
32.	There are different locomotives and I need to learn too much information.	2.47(1.47)	59
	Social factors		
33.	My work schedule interferes with my personal lives and leisure activities	3.65(0.81)	96
34.	Lack of opportunities for communication with other colleagues is among the weaknesses in my career.	3.02(1.09)	71
35.	Travelling between home and work is very time-consuming	2.97(1.44)	73
	Individual factors		
36.	My job fails to meet my expectations.	2.91(1.18)	77
37.	There is no emotional fitness for me at work.	1.88(1.48)	36
38.	There is no physical fitness for me at work.	1.77(1.58)	36
	Organizational factors		
39.	Job benefits are insufficient in my career.	3.74(0.69)	95
40.	Meal facilities are unsatisfactory.	3.54(1.00)	90.8
41.	Job promotion process for train drivers is inappropriate in my organization.	3.41(1.06)	83
42.	There is an inconsistency between constitution, discipline, rules and the administrative actions	3.30(1.00)	84
43.	Facing unscheduled train stops during trips makes me tired.	3.28(1.00)	81.6
44.	Work schedules provided by the relevant department are irregular.	3.20(1.20)	79.8
45.	I believe that training and refresher courses are insufficient.	3.09(1.16)	76.8
46.	I believe that training courses have low quality.	3.06(1.18)	75
47.	I believe that training courses are unnecessary.	1.34(1.34)	18

Environmental Factors (Physical Factors, Design Related Factors, Working Condition)

As can be seen from table 1 Collisions with people, collisions with animals and sabotage were the environmental factors drivers were most concerned about, as demonstrated by the high percentage of drivers (99%, 98% and 98% respectively) selecting 3 or 4 for these issues. However, the findings showed that design related factors such as visibility from driver's cab, arrangement of equipment and tools, and controls equipment layout, signs and indicators, and lighting during day and night were not as important as other environmental factors.

Task Related Factors

The majority of drivers were dissatisfied with nearly the whole task-related factors. Excessive and irregular working hours (mean=3.65), the need for mental concentration (mean=3.64), high responsibility (mean=3.52), consecutive night and early morning shifts (mean=3.36), falling asleep during driving (mean=3.25), drowsiness while driving (mean=3.23) and time pressure (mean=3.12) were respectively the most remarkable task-related factors.

Social Factors

Ninety-six percent of train drivers in our study agreed with "interference of work schedule with personal lives and leisure activities" as an obstacle related to the social aspect of their job. The rest of the items in this category were not so important.

Individual Factors

Of the three obstacles related to individual factors, which were evaluated in the present study, failure to meet train driver's job expectations with mean score of 2.91(±1.18) was the most important one.

Organizational Factors

The most important organizational issue belongs to insufficient job benefits with mean score of 3.74. Other organizational factors that emerged to be serious were respectively unsatisfactory meal facilities, inappropriate job promotion process, inconsistency between constitutions, discipline, rules and the administrative actions, unscheduled train stops, irregular work schedule, insufficient training and refresher courses and low quality training courses. However, most of drivers thought that training courses were necessary because only 18% of drivers rated it to be a problem.

Figure 1 illustrates the total sum of all answers of each aspects of the questionnaire (with the highest score of 100). A linear transformation was used to transform the raw sum scores to 0-100 score. As can be seen, task related factors with sum score of 88.44 and individual factors with sum score of 54.67 had respectively the highest and lowest score among all aspects of the questionnaire.

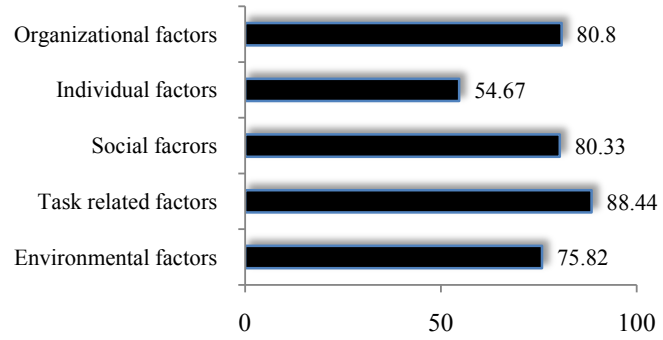

Figure 1. Sum scores of five categories of the performance obstacle questionnaire (0-100)

DISCUSSION

In this paper, the most important performance obstacles of Iranian train drivers have been classified and presented from the viewpoint of ergonomics via interviews and a questionnaire. The interview helped us to identify train drivers performance obstacles in detail which would be useful in future studies related to implementing some intervention studies. As mentioned before, several obstacles related to train drivers' working condition have been identified in the previous studies but this study attempts to cover all aspects of train driving. The most important obtained performance obstacles are discussed further below.

Overall, it was shown that of the many environmental factors, collisions with people and animals resulting in death or injury, was the most important issue which train drivers were concerned about. The result of our study is compatible with findings of Austin and Drummond (1986) which was shown that train fatalities were the greatest concern of train drivers. On-the-track accidents happen when an object (vehicle, animal, and person) is on the line, the train speed is high and there is no chance for driver to brake in time and control the situation. A large number of researches have investigated train drivers' symptoms after an accident. For instance, Malt et al. (1993) found that 1/3 of the train drivers reported symptoms of acute psychophysiological arousal after accidents. Additionally, it was shown by Tranah and Farmer (1994) that one-third of drivers, who experienced persons jumping in front of their

trains (in the case of railway suicide), suffered a severe reaction and even in some cases they struggled with mental disorders.

What is more, in our country rail tracks are completely open and the accessibility to open track is easy. Previous researches suggested that installation of barriers or platform screen doors (PSDs) to restrict access to the tracks is one of the most effective measures (Baumert et al., 2006; Beskow et al., 1994; Clarke, 1994; Clarke and Poyner, 1994; Coats and Walter, 1999; Law et al., 2009; Lindekilde and Wang, 1985; Mishara, 2007; O'Donnell and Farmer, 1992). Unfortunately, the cost of installing barriers is exorbitant and organizations refuse to use this method (Baumert et al., 2006; Beautrais, 2007; Kerkhof, 2003; Mishara, 1999, 2007). Another solution is to giving train drivers a few days off and providing psychological consultation following an accident to help train drivers cope with the situation easier (Austin and Drummond, 1986). In terms of physical factors, the lack of unsatisfactory toilet facilities was another most important problem of train drivers in the current study. Welfare facilities and services are among the basic requirements that organizations should provide for their staff. Toilet facilities are barely adequate in train cabs. The cabs should be equipped with toilet and in the case that toilet exists, sanitation facilities should be enhanced.

Regarding task related factors, the results of our study demonstrated that most of the drivers were concerned about their excessive and inconvenient working hours, which is in accordance with the results of Austin and Drummond (1986). It was also shown that task related factors obtained the highest score among all aspects of the questionnaire (Figure 1). Shiftwork is an inevitable part of train driving in which the driver has to work at unusual hours including night and early morning. The normal circadian rhythm is influenced by working hours (Åkerstedt, 2003; Harrington, 2001; Kecklund et al., 1999). Train driver's unpleasant scheduling especially early morning and nigh shifts interferes with sleep-wake cycle (Ferguson et al., 2008; Tepas and Mahan, 1989) and leads to increased level of sleepiness (Härmä et al., 2002) and fatigue-related problems (Åkerstedt, 1991; Folkard and Monk, 1979) which have detrimental impacts on safety, and increase risk of accidents and error (De Vries-Griever and Meijman, 1987). It was revealed in the interviews that train drivers in our study suffered from fatigue and lack of sleep due to inappropriate working and resting time. According to their work schedule, period of rest that can be taken by train drivers is equal after a long-haul and after a short-haul trip. Moreover, most of the time their shift duration exceeds the normal time due to some irregularities. Dorrian et al. (2011) found that sleep length, shift duration and night shift were important factors to predict high level of fatigue. Furthermore, in a previous study it was shown that accident risk for train driving was doubled after 4 hours of consecutive driving (Chang and Ju, 2008). Kecklund et al. (1999) recommended that train drivers' shifts should be predictable and not too long and they should be allowed to have influence on their working hours. It is important to focus on time and duration of shifts, work hours in a week, rest periods, and the number of successive night or early morning shifts.

The majority of train drivers in our study agreed with "work schedule interference with personal lives and leisure activities" as the most important social factors. Work life balance is an important issue that impacts employee's quality of working life (Van Laar et al., 2007). Issues such as adequate facilities at work, flexible working hours and the understanding of managers, influence employee's work life balance (Garg et al., 2012). Due to the nature of their work, train drivers have no control over the time of their shifts and their work involves erratic working hours. Besides usually being away from home, they also work some weekends and holidays. It would be better that railway organization adopts effective work balance policies to retain its employees and increase the whole productivity of the system.

Concerning the individual factors, failure to meet train driver's job expectations has obtained the highest score (Table 1). Organizations are liable to keep applicants of train driving well informed about all aspects of the job. Train drivers in our study declared that their organization did not give them adequate information about multiple aspects of their work which made them hopeless after starting their job.

According to result of our study, insufficient job benefits were the most important organizational factor. Train drivers in the current study believed that compared to their high responsibilities and their unfavorable working condition including terrible condition of cabin, they do not receive enough job benefits and they are dissatisfied with the amount of money they are paid. Based on the Two-factor theory of Herzberg, salary is among the factors which is essential to prevent employees' dissatisfaction.

CONCLUSIONS

In the present study, the performance obstacles experienced by Iranian train drivers was introduced and prioritized in five categories. Train driving is among jobs which despite its importance few related studies have been carried out in Iran. Most of the identified obstacles in the present research belonged to the category of environmental factors, as they were one of the main concerns for the train drivers working in such environmental conditions. The importance of environmental issues from the view point of train drivers shows the high priority of these issues in implementing interventions. Furthermore, the wide range of identified obstacles reveals that ergonomics interventions to the train driving work system should be considered in order to improve performance of train drivers and subsequently enhance the quality of the whole system.

STUDY LIMITATIONS

There were some limitations with the present study that should be acknowledged. The first limitation is that we just focused on self-reported data obtained from train drivers and it is possible that respondents exaggerated about their working conditions because they were dissatisfied with their organization. Therefore, it is recommended to focus on each obstacle in detail, based on more objective measures such as performance indicators in the future studies. What is more, the participants in our study were selected from only 2 train operating companies, which may limit the comprehensiveness of the results regarding the obstacles categorization. Therefore, further research is needed to be conducted to explore train drivers' problems in other train operating companies and also in other regions of the country.

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